A. COVER SHEET – CALFED BAY-DELTA PROPOSAL

1. CALFED BAY-DELTA Program
Agricultural Funding Proposal Draft Dated ---- February 8, 2001

2. Proposal Title –

Implementing real-time automatic irrigation control, water measurement, scientific scheduling, and two-way data sharing between farmers and other water stakeholders

3. Principal applicant:
Underhill International Corporation

4. Contact:
Gary Underhill
Secretary/Treasurer

5. Mailing address:
Underhill International Corporation
430 Forest Avenue
Laguna Beach, CA 92651

6. Telephone:
949-494-7756

7. Fax:
949-494-7886

8. E-mail
Gunderhill@uicorp.net
Underhill@uicorp.net

9. Funds Requested:

Part A:	$ 85,000	Cost/benefit refinement and target district selection
Part B:	$410,000	2001 Implementation 16,000 acres if Part A results are positive
	$410,000	2002 Implementation 16,000 acres if 2001 Part B results are positive

10. Applicant cost share funds pledged – dollar amount: none

11. Duration –
Part A: June 1, 2001 to November 1, 2001
Part B: January 1, 2002 to three years after contract date subject to review upon completion Part A

12. State Assembly and Senate districts and Congressional district(s) where the project is to be conducted: All relevant districts within the Cal-Fed Sub-Region boundaries plus the Imperial Irrigation District

13. Location and geographic boundaries of the project:
Same as item 12 above

14. Name and signature of official representing applicant. By signing below, the applicant declares the following:
----- the truthfulness of all representations in the proposal;
----- the individual signing the form is authorized to submit the application on behalf of the applicant;
----- the applicant will comply with the contract terms and conditions identified in Section 11 of this PSP

Gary Underhill
Secretary-Treasurer --Underhill International Corporation

B. Scope of work

Relevance and Importance

1. Abstract (Executive Summary)

Project description –

This proposal is in two parts:

Part A is to gather and refine data, and to select and rank ten irrigation districts to target for Part B implementation of real-time on-farm irrigation automation. The ultimate objective is to provide farmers and districts the means to control, measure, schedule, share, and compare water-use efficiencies. It is expected that with proper incentives, and blind and/or attributed two-way data sharing between farmers and other stakeholders, an average of at least a 10% reduction in total applied water (TAW) will result.

Further, Part A will estimate the total acreage that could be automated economically and ranked in order of estimated benefits and costs.

Preliminary cost estimates are included as part of this proposal in Excel in order to allow further sensitivity analysis if desired. Long-term costs are based on automating in 320,000-acre tranches in order to achieve economies of scale. Using a 15year life and a 6% discount factor, the annualized cost to automate and manage is about $8 per acre per year including management and equipment. The annual cost per acre-foot reduction in TAW is about $22. TAW is used as the relevant measure in order to address environmental considerations as well as to provide a basis for assessing net water demand on a district-wide basis.

More specifically, the most promising top ten districts will be ranked for implementation based on the following criteria:

1. District management interest in adapting new technologies
2. District support capabilities to implement new technologies
3. Potential for the greatest environmental impact
4. District and farmer willingness to share in costs of implementation
5. Concentration of farms with high benefit/cost ratios suitable for automation
6. Total applied water potential savings
7. Irrecoverable loss potential savings

Part B contemplates favorable results from Part A and is for the implementation of automation on selected and approved targets of 16,000 acres in 2002 and another 16,000 acres in 2003, or sooner based on early results. Part B proposes to implement this technology within four cooperating districts that have the interest and ability to support the technology. Please refer to the attachment for preliminary cost estimates. These cost estimates are based on UI experience applying similar technology on approximately 50,000 acres of low-cash grain crops.

Upon implementation, farmers will have the option to monitor and control irrigation with a dedicated PC or by automated telephone control via their farm office or district office. Crop water use will be supplied using automatically calculated reference ET, crop coefficients, automated changes in growth stage, with soil inventories occasionally confirmed by hand soil probe data. Further software will be developed in Part B in order to routinely collect, summarize and post field-by-field results on the web in order to provide feedback to farmers, districts and other stakeholders. Such web software will be of an open architecture thus allowing various field control systems to post data conforming to the formats in the web.

Underhill International (UI) has five-years' experience providing similar automation to low-cash-crop farmers in the high plains. It is imperative for farmers to have an economic motivation to conserve. To enable farmers to conserve, they must be provided data gathered automatically accompanied with automatically analyzed recommendations for management control. This data must be supplied in close to real time, and be succinctly and promptly summarized for the farmer. Ultimately, the farmer must be coached whether to "Go", "NoGo", "Go When", and for "How Long". These recommendations must be subject to his final approval.

2. Critical Issues

Scarcity and low costs rarely go hand in hand. Given relatively low cost water and power combined with a very difficult farm economy, there is little motivation, much less the means, to conserve. Farmers have made their investments based largely on historically low cost resource commitments. Except for environmental considerations, it is difficult to change the rules without incentives. Although research indicates there is often an economic yield loss due to over-watering, such incentives are largely discounted by farmers except in the case of high-value crops that are water sensitive.

The strategic critical issue is obvious: provide farmers and water districts the incentives and the means to conserve or it just will not happen without extensive regulation.

The tactical issue is how to control and monitor TAW. TAW is the most relevant and reasonably measurable target irrigation variable to address. It must be measured and controlled in order for CALFED to accomplish its objectives. TAW is the primary determinant of downstream surface and ground water quality, irrecoverable losses, and power consumption. It is the common thread throughout all CALFED sub-regions and all measurable objectives. TAW conservation can be controlled by dictate or incentives, but ultimately only controlled by the farmer. The farmer must be provided the incentives and the means to make decisions that are in his own as well as the public's best interests. TAW must be monitored and controlled on as many fields as is economically practical. It may not lend itself to tight control on all fields. The fields with the most total impact should be automated first.

The field-level data required providing the means is as follows:

- Supply data estimates
  - System capacity
  - Current flow rates
  - Gross rainfall received
  - Rain runoff estimates
  - Hours run
  - Application per irrigation

- Demand data estimates
  - Irrigation system efficiencies
    - Evaporative losses
    - Application uniformity losses
  - Daily reference ET
  - Crop coefficients
  - Estimates of projected ET
  - Current crop grow stage
  - Rate of change of growth stage

- Available Soil Moisture Inventory estimates
  - Available soil moisture holding capacities
  - Spatial soil variability
  - Current inventory in active root zone
  - Current inventory in mature root zone
  - Soil moisture release rates
  - Physical verification of inventories (probe data)
    - Hand
    - Portable instruments
    - Fixed instruments
  - Inventory data acquisition
    - Communications from field
    - Personal observations
    - Instrumented automatic readings

3. Nature, scope, and objectives of the project

Part A –

Data gathering and cost refinements

Upon gathering the necessary field data, cost estimates will be prepared utilizing presently marketed mechanical and electronic control devices as well as new potential cost-effective devices that could be reasonably developed by manufacturers in the near future. The elements for the technology exist, but must be assembled and implemented.

Estimates will be prepared for generic classes of turnouts, locations, capacities, supply conveyance systems, acres served, and crops. Estimates will be provided for flow controls, valves meters, power sources, communication systems, and software developments as may be required for near real time data gathering and decisions.

Benefit estimates (economic and environmental) to farmers, water districts, DWR, and the public will be estimated and quantified where possible.

The core objective of Part A is to identify the districts with turnouts that may lend themselves most economically and readily to automation with the greatest total benefits. Objective economic benefits will be estimated for reduction in TAW per acre.

Environmental benefits will be assigned for each sub-region for TAW per AF. Each sub-region's environmental benefit must be based on a CALFED judgement expressed in a $/AF value. Absent a Cal-Fed estimate, a cost/benefit ratio excluding environmental considerations will be used for ranking.

4. Methods, procedures and facilities

a. Review existing data sources to determine turnout quantities, sizes, characteristics and acres per turnout from the following sources:

- DWR
- Districts

b. Conduct preliminary interviews to gain perspective and to develop data recording formats

- Five selected districts
- Five farmers per district

c. Select priority districts for in depth study (probably 25 to 35)

d. Refine data format for interviews

- Environmental issues
- Number of outlets
- Types of outlets
- Water use histories by turnout
- Maps
- Crops
- Irrigation system types
- Problems to solve
- Perceived farmer benefits
- Perceived district benefits
- Objections
- Perceived public benefits and objections

e. Develop costs estimates for automation equipment requirements by class and size of turnout

- Hardware
- Communications
- Software

f. Summarize costs in histograms such as $/AF costs of TAW by

- Class of turnout
- Size of turnout

g. Summarize objective economic benefits in histograms such as $/AF saved by:

- Farmers
- Districts
- Public

h. Assign each district judgmentally quantified values for environmental needs

i. Rank targets by cost/benefit ratios

j. Rank targets by total TAW potential savings

k. Rank by criteria listed in executive summary. Select best targets

l. Target priority lists based on estimated marginal costs and marginal benefits.

m. Refine Part B implementation plans including outreach requirements.

5. Schedule:
Part A
June 1 to July 31 – Complete items a, b, c, and d above

August 1 to October 30 – Complete items e, f, and g, h above

November 1 to November 30 – Complete items I, j, k, l, m above and submit final report

Part B if, warranted
December 1 implementation plan approval and commence implementation

April 1 installation complete

6. Monitoring and Assessment
Part A
All field visits will be documented and data recorded in structured Excel format.
Monthly and other required reports to be submitted by E-mail along with a progress summary.

C. Outreach, community involvement, and information transfer

Part A
None

Part B
Outreach and training programs will be developed with cooperating irrigation districts during Part B implementation.

D. Qualifications of the applicants, cooperators, and establishment of partnerships

1. Resume of project management

Underhill International Corporation is to be the Project Manager for Parts A and B.

Gary Underhill, founder and Secretary/Treasurer of Underhill International Corporation will direct the Part A work. Part B implementation and personnel selection is contingent on the results of Part A. If implemented, it will be managed by a Project Manager to be assigned.

Resume of Underhill International Corporation (UI)
Founded – 1980; 10 employees
UI Principal activities –

Pivot-Alert -- Utilizing software, firmware, and electronics sub-contractors, UI developed and has marketed since 1996 its proprietary Pivot-Alert product line. Several hundred systems are operating on field crops in Kansas and New Mexico. Pivot-Alert controls, monitors, notifies and calculates ET requirements based on the same variables that are required for any irrigation system.

Distributed Products – In addition to Pivot-Alert, UI offers complete ranges of agricultural and landscape irrigation equipment worldwide. These products are manufactured by approximately 30 U.S. and international independent irrigation manufacturers and are sold to approximately 200 customers in 70 countries.

Key personnel have BS, MS, BA, MBA business, science, and/or agricultural degrees. Software and firmware key sub-contractors have BS, MS degrees in EE and computer sciences.

A review of UI distributed and proprietary products and a Pivot-Alert Power Point presentation can be viewed on our web site www.uicorp.net.

Resume of Gary Underhill
1954-1959
BS Geology University of Kansas
Navy Scholarship
1959-1962
U.S. Navy line officer
Engineering, deck and gunnery department head USS Whitfield County
1962-1964
MBA
Stanford University
1964-1980 Rain Bird Sprinkler Manufacturing
Vice President U.S. & International Marketing
1980 to present
Underhill International Corporation
References:
Dr. Jack Keller, Keller-Bliesner Engineering, Logan, Utah
Richard Wenstrom, Kinsley, Kansas farmer and irrigation consultant
Joe Lord, JM Lord, Inc, Fresno, CA

2. External cooperators

Parts A and B
Independent consultants including
Dr. Mark Roberson
1999 Ph.D. Soil Chemistry, University of California, Riverside
1992 to 1997

3. Partnerships for implementation

Part B
Possibly selected water district conservation specialists

E. Costs and Benefits

1. Budget summary and breakdown

   See Excel Part B 32,000 acre worksheet and 320,000 worksheets attached
   Proposal Part B Implementation

2. Budget justification

   Part A is based on personnel and overhead costs required to gather sufficient data to identify selected targets for implementation of Part B, and to estimate the total acres that could be served throughout the CALFED BAY-DELTA program area.
   Part B is based on the estimated costs to implement a pilot program on 200 fields implemented in two 16,000-acre tranches in 2002 and 2003. The cost to implement the program on 2,000 acres is supplied in order to estimate the sensitivity of costs to economies of scale.

3. Benefit summary and breakdown
   a. Quantify project outcomes and benefits –
      Refer to Excel attachment
   b. Non-quantifiable project outcomes and benefits -
      It is not within the scope of work to attempt to quantify the environmental benefits except to provide the means to allow others to assign an environmental benefit to TAW savings within a district expressed in $/AF TAW saved.

4. Assessment of costs and benefits
   a. The major assumptions are
      Farmers and districts can be positively motivated to conserve by using and sharing better data
      Data sharing and ranking can guide farmers to better irrigation practices
      Benefits, costs, present value are contained in Excel attachment
   b. All costs are in 2000 dollars
   c. Capital costs are annualized at 6% discount rate using a 15 year equipment life
   d. Table and calculation of quantified costs – see Excel attachment

F. **Matching funds Commitment Letter**

None

G. Letter of Concurrence from Local Government

Not applicable

H. **Environmental Documentation**

Not applicable

11. Contract terms and conditions

There are no contract terms that appear to be objectionable to the applicant. Software enhancements to UI programs shall remain the property of UI. Software developed specifically for web communications shall be the property of CALFED with UI having unlimited rights to use the software. Payment terms shall include monthly progress payments as negotiated.

CALFED - UNDERHILL INTERNATIONAL PROPOSAL FEBRUARY 8, 2001
Budget Summary - Proposal Section E.1

	Budget Summary Catgegories	Qty	$/unit	total
a	**Salaries w/overhead & profit applied**			
	Program manager w/overhead	1	$ 50,000	$ 50,000
b	**Benefits & Taxes**			
	Benefits & employment taxes	1	$ 10,000	$ 10,000
c	**Supplies**			
	None	0	$ -	$ -
d	**Equipment**			
	None	0	$ -	$ -
e	**Services & consultants**			
	Cooperating consultants	1	$ 15,000	$ 15,000
f	**Travel**			
	Travel & telephone	1	$ 10,000	$ 10,000
g	**Other direct costs**			
h	**Total Estimated Annual Costs**			$ 85,000
	Total Annual Costs			

CALFED - UNDERHILL INTERNATIONAL PROPOSAL FEBRUARY 8, 2001
Budget Summary

32,000 acres Part B--Implementation of Two Tranches- Each of 16,000 Acres

Management after installation is for service training, outreach, and operation
This proposal is to supply management for three years from contract execution
After three years, the following and other options will be assessed:

Turn all management over to districts
Combine project management with district services
Use this project management to expand the program
UI is to receive one year notice prior to project management changes
Additional software and firmware programming may be minimal after three years

	Budget Summary Catgegories	**Units**	**Qty**	**$/unit**	**total**
a	**Salaries w/overhead & profit applied**				
	Program manager w/overhead	Annually	1	$ 100,000	$ 100,000
	Field service support & training	Annually	1	$ 80,000	$ 80,000
b	**Benefits & Taxes**				
	Benefits & employment taxes	Annually	1	$ 36,000	$ 36,000
c	**Supplies**				
	Outreach supplies	Annually	1	$ 20,000	$ 20,000
d	**Equipment**				
	Equipment costs below	Acres	32,000	$ 1.76	$ 56,432
e	**Services & consultants**				
	Software firmware programming	Annually	1	$ 50,000	$ 50,000
f	**Travel**				
	Travel & telephone	Annually	1	$ 35,000	$ 35,000
g	**Other direct costs**				
	Software field license & support	Per field unit/year	200	$ 200	$ 40,000
	Repairs; towers and field	Per field unit/year	200	$ 25	$ 5,000
	Contingency	$/A/Year	32,000	$ 2.00	$ 64,000
	Farmer or district check probes	$/A/Year	32,000	$ 2.00	
h	**Total Estimated Annual Costs**				$ 486,432
	Total Annual Costs				
	Equipment $/A/Year At 15 year life 6% interest				$ 1.76
	Equipment $/Year At 15 year life 6% interest				$ 56,432.00
Initial Capital Costs					
	Towers		4	$ 5,000	$ 20,000
	Field monitoring and control equipment		200	$ 2,500	$ 500,000
	District office monitoring and control		4	$ 5,000	$ 20,000
	Electronic water meters		200	$ 600	$ 120,000
	Tipping Automaic Rain gauges		200	$ 100	$ 20,000
	Hi-Lo pressure switches		200	$ 100	$ 20,000
	Soil sensor sets		200	$ 300	$ 60,000
	Spares		20	$ 2,500	$ 50,000
	Installation by district personnel		200	$ 150	$ 30,000
	Total equipment capital cost				$ 820,000
	Summary of costs 32,000 acres				
	Acres		200	160	32,000

Capital cost per acre			$	26
Annualized costs of equipment @6%, 15 year life			$	56,432
Per Acre/year cost summary				
Equipment	$	1.76		
Management, operation, training and outreach; 32,000 acres	$	13.44		
Contingency	$	1.00		
TOTAL PROJECT WATER MANAGEMENT COSTS/A/YR	$	16.20		
Probe occasional manual checks; consultant, district or farmer	$	2.00		

$/AF Total Appled Water

% TAW reduction			10%
Estimated current average TAW now applied			3.5
Acres			32,000
TAW AF gross reduction per year			11,200
Total project cost per year		$	518,432.00
Cost per A/Yr		$	16.20
Total cost per AF TAW		**$**	**46.29**
Irrecoverable losses	Unknown		
Environmental losses	Unknown		

CALFED - UNDERHILL INTERNATIONAL PROPOSAL FEBRUARY 8, 2001
Annualized Budget Summary - For Perspective of & Economies of scale
320,000 Acres
Management will be required for at least three years after installation
Management for training, outreach, operation and maintenance support
After three years, the following and other options will be assessed:
Turn all management over to districts
Combine UI project management with district services
Use UI project management to expand the program
UI is to receive one year notice prior to project management cancelation
Office space to be supplied by a cooperating districts

	Budget Summary Catgegories	**Units**	**Qty**	**$/unit**	**total**
a	**Salaries w/overhead & profit applied**				
	Program manager w/overhead	Annually	1	$ 180,000	$ 180,000
	Field service support & training	Annually	2	$ 80,000	$ 160,000
b	**Benefits & Taxes**				
	Benefits & employment taxes	Annually	1	$ 52,000	$ 52,000
c	**Supplies**				
	Outreach supplies	Annually	1	$ 30,000	$ 30,000
d	**Equipment**				
	Equipment costs below	Acres	320,000	$ 1.67	$ 535,074
e	**Services & consultants**				
	Software firmware programming	Annually	1	$ 25,000	$ 25,000
f	**Travel**				
	Travel & telephone	Annually	1	$ 50,000	$ 50,000
g	**Other direct costs**				
	Software license & support	Per field unit/year	2,000	$ 200	$ 400,000
	Repairs; towers and field	Per field unit/year	2,000	$ 25	$ 50,000
	Contingency	$/A/Year	320,000	$ 2.00	$ 640,000
	Farmer or district check probes	$/A/Year	320,000	$ 2.00	
h	**Total Estimated Annual Costs**				$ 2,122,074
	Total Annual Costs				
	Equipment $/Year At 15 year life 6% interest				$ 535,074

Initial Capital Costs

Towers	5	$ 5,000	$ 25,000
Field monitoring and control equipment	2000	$ 2,500	$ 5,000,000
District office monitoring and control	5	$ 5,000	$ 25,000
Electronic water meters	2000	$ 600	$ 1,200,000
Tipping Automaic Rain gauges	2000	$ 100	$ 200,000
Hi-Lo pressure switches	2000	$ 100	$ 200,000
Soil sensor sets	2000	$ 300	$ 600,000
Spares	100	$ 2,500	$ 250,000
Installation by district personnel	2000	$ 150	$ 300,000
			$ 7,775,000

Summary of costs 320,000 acres			
Acres	2000	160	320,000

Capital cost per acre			$	24
Annualized costs of equipment @6%, 15 year life			$	535,074
Per Acre/year cost summary				
Equipment	$	1.67		
Management, operation, training and outreach	$	4.96		
Contingency	$	1.00		
TOTAL PROJECT WATER MANAGEMENT COSTS/A/YR	$	7.63		
Probe occasional manual checks; consultant, district or farmer	$	2.00		

$/AF Total Appled Water

% TAW reduction			10%
Estimated current average TAW now applied			3.5
Acres			320,000
TAW AF gross reduction per year			112,000
Total project cost per year with contingency		$	2,442,074
Cost per A/Yr		$	7.63
Total cost per AF TAW		**$**	**21.80**
Irrecoverable losses	Unknown		
Environmental losses	Unknown		